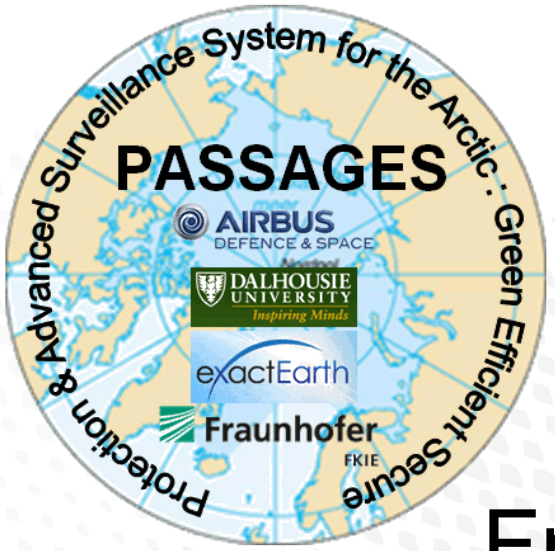


# From Sensing to Sense-Making

## Assessing and visualizing ship operational limitations in the Canadian Arctic using open-access ice data

Mark A. Stoddard, Dalhousie University (**presenter**)
Dr. Laurent Etienne, University of Tours
Dr. Ronald Pelot, Dalhousie University

Ship Arc 2015, Malmo, Sweden, August 26, 2015



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# The Canadian Arctic presents a unique operating environment where first-hand experience is limited, and risks are widely known but not well understood.



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# OUTLINE

- A few pragmatic assumptions
- What are we trying to accomplish in our study?
- Assessing and Visualizing Ship Operational Limitations in Ice
- Risk Visualization Examples
- Conclusions

# Pragmatic Assumptions

- Risks to ships in the Arctic are well known by existing ship operators
- Assessing the risks associated with maritime activity (planned or observed) will be integral to sustaining increased activity in the Arctic.
- New methods to improve sense-making and situational awareness are required to allow maritime stakeholders to plan, adapt and respond to uncertain, unknown, and known situations.

# What are we trying to accomplish in our study?

- Identify relevant cross-domain data sources and integrate existing data representations and ontologies
- Examine existing risk assessment frameworks and calculation methods
- Develop and test new concepts for calculation, visualization, and communication of voyage / route risk.
- Improve understanding of the value of information for maritime decision making

# Assessing and Visualizing Ship Operational Limitations in Ice

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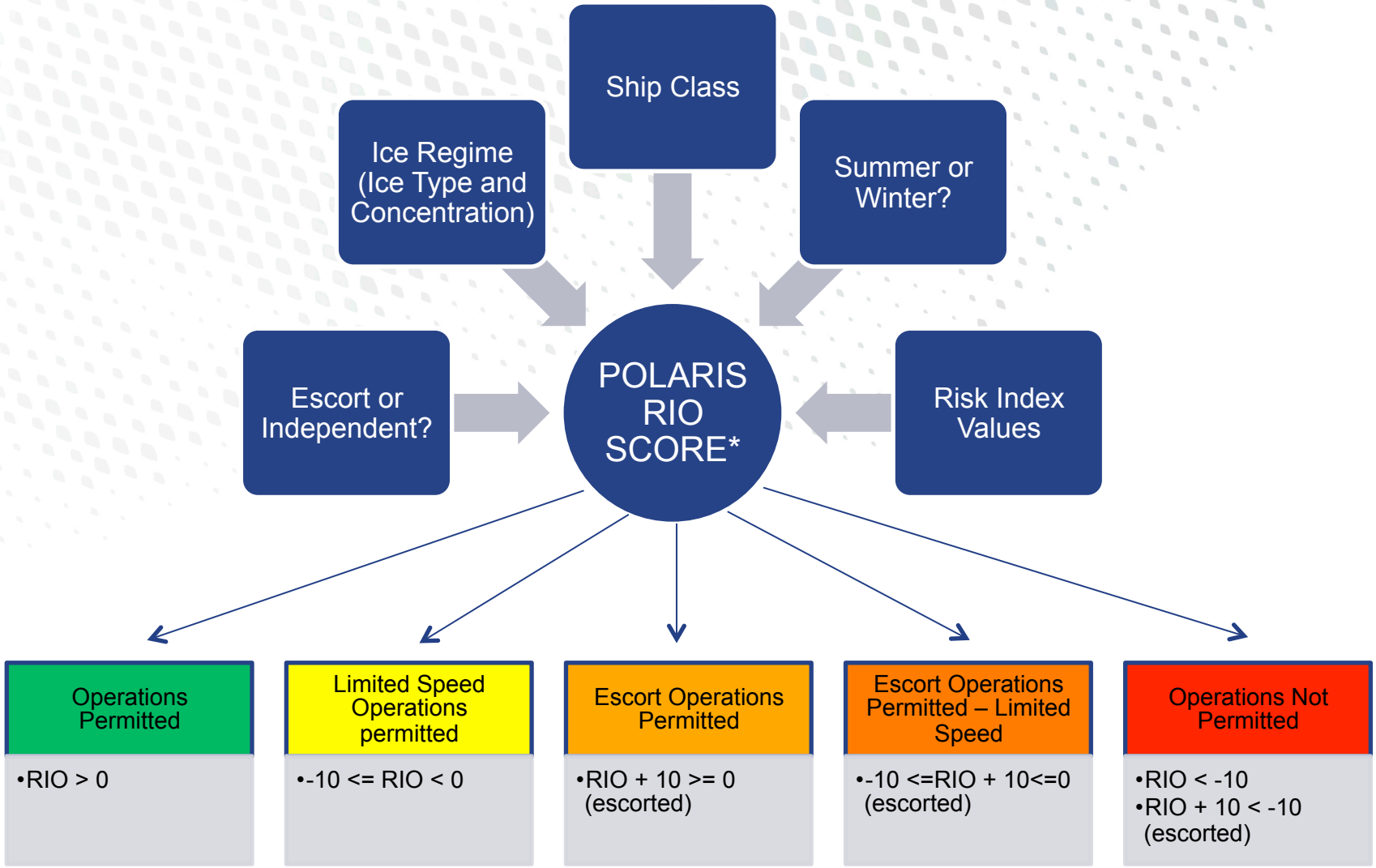
# Polar Operational Limitations Assessment Risk Indexing System (POLARIS)

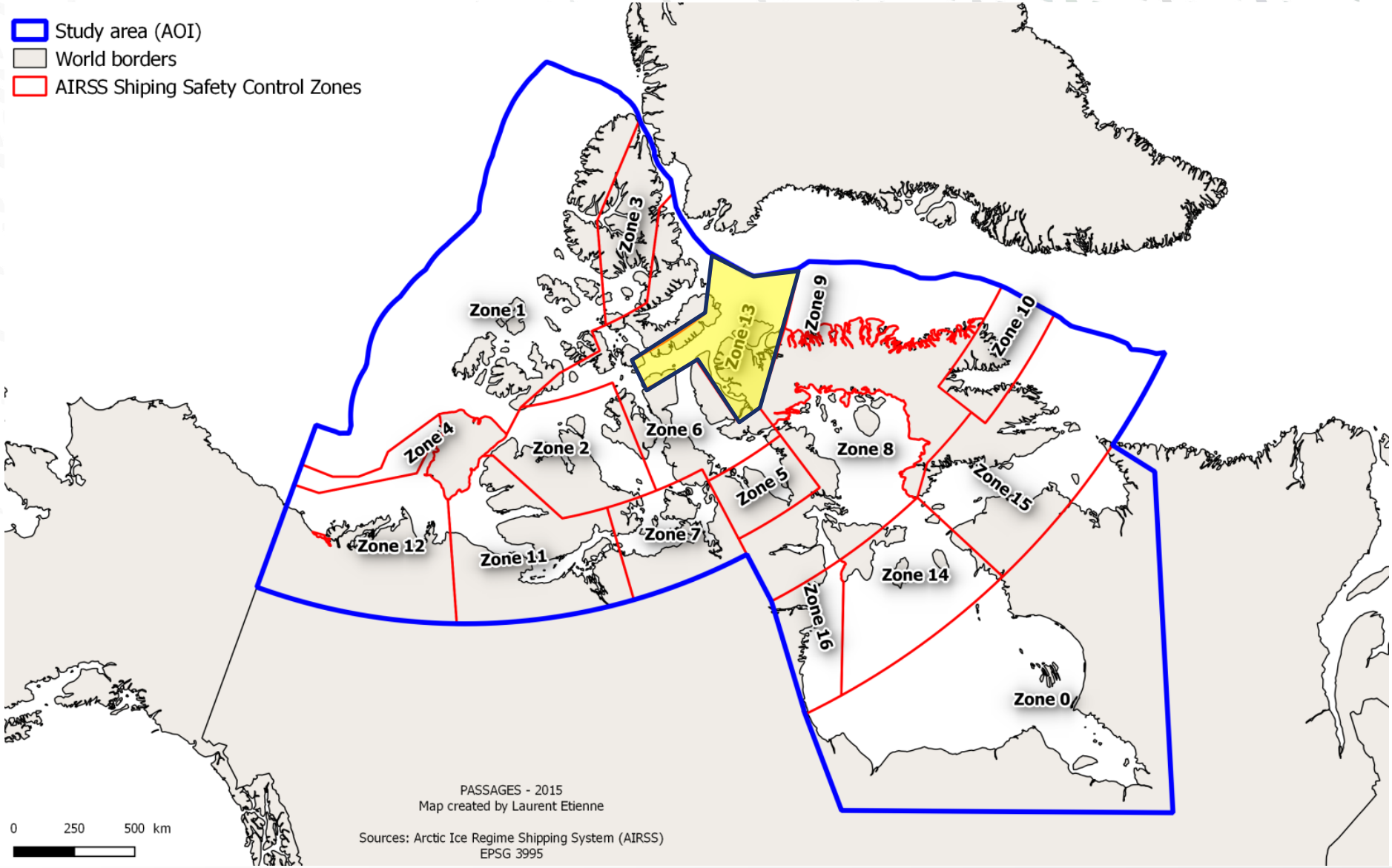
- Proposed risk assessment framework for determining ship operational limitations in ice
- Produced by the International Association of Classification Societies (IACS)
- POLARIS provides a basic calculation to assess ship limitations based on a Risk Index Outcome (RIO)

# POLARIS RIO and Evaluation Criteria



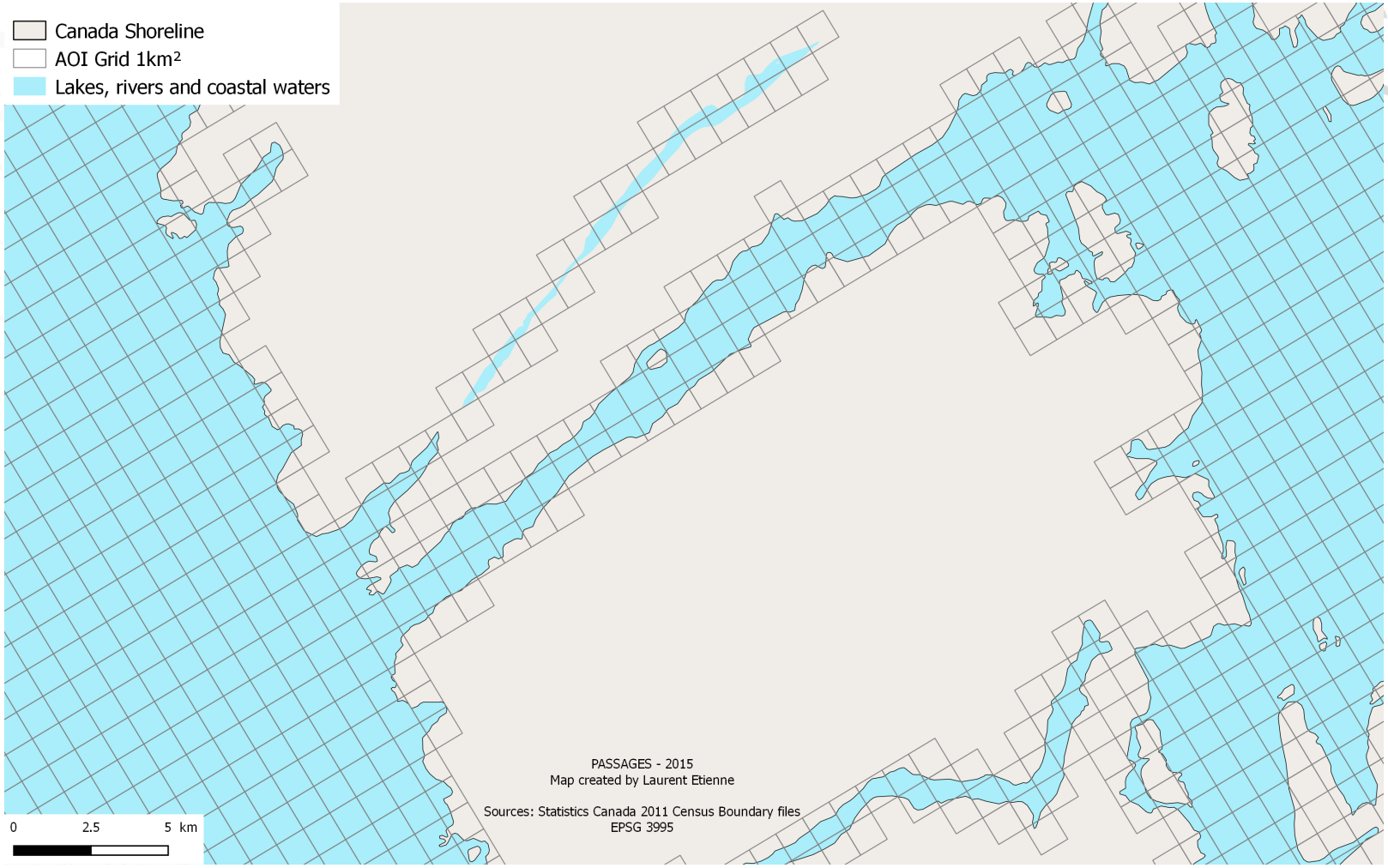

* MSC 94 – Technical Background to POLARIS (2014)

# Area of Interest (AOI)



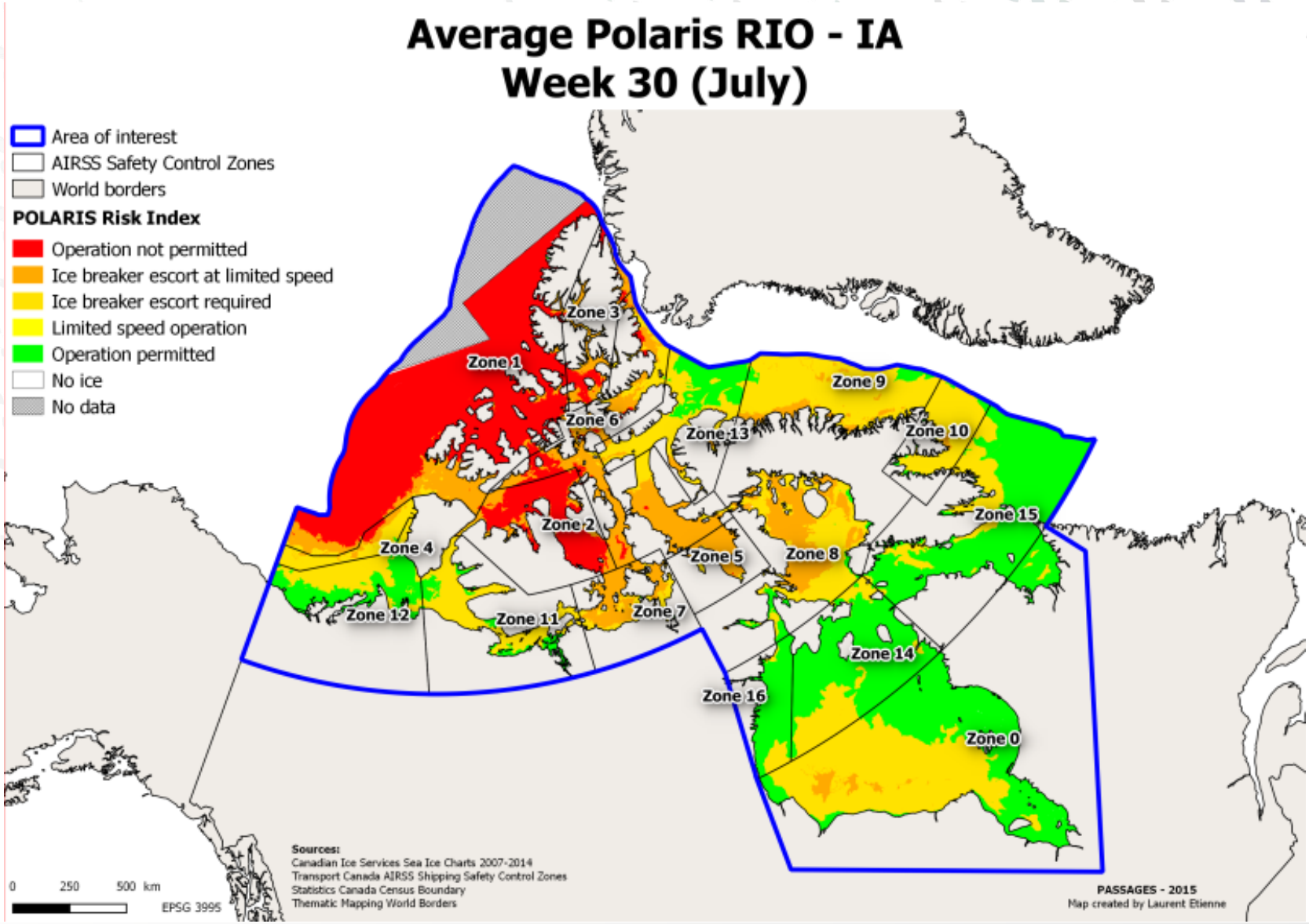
# AOI Tessellation and Ice Data Association

## Bellot Strait Area of Interest Grid (1 km² resolution)

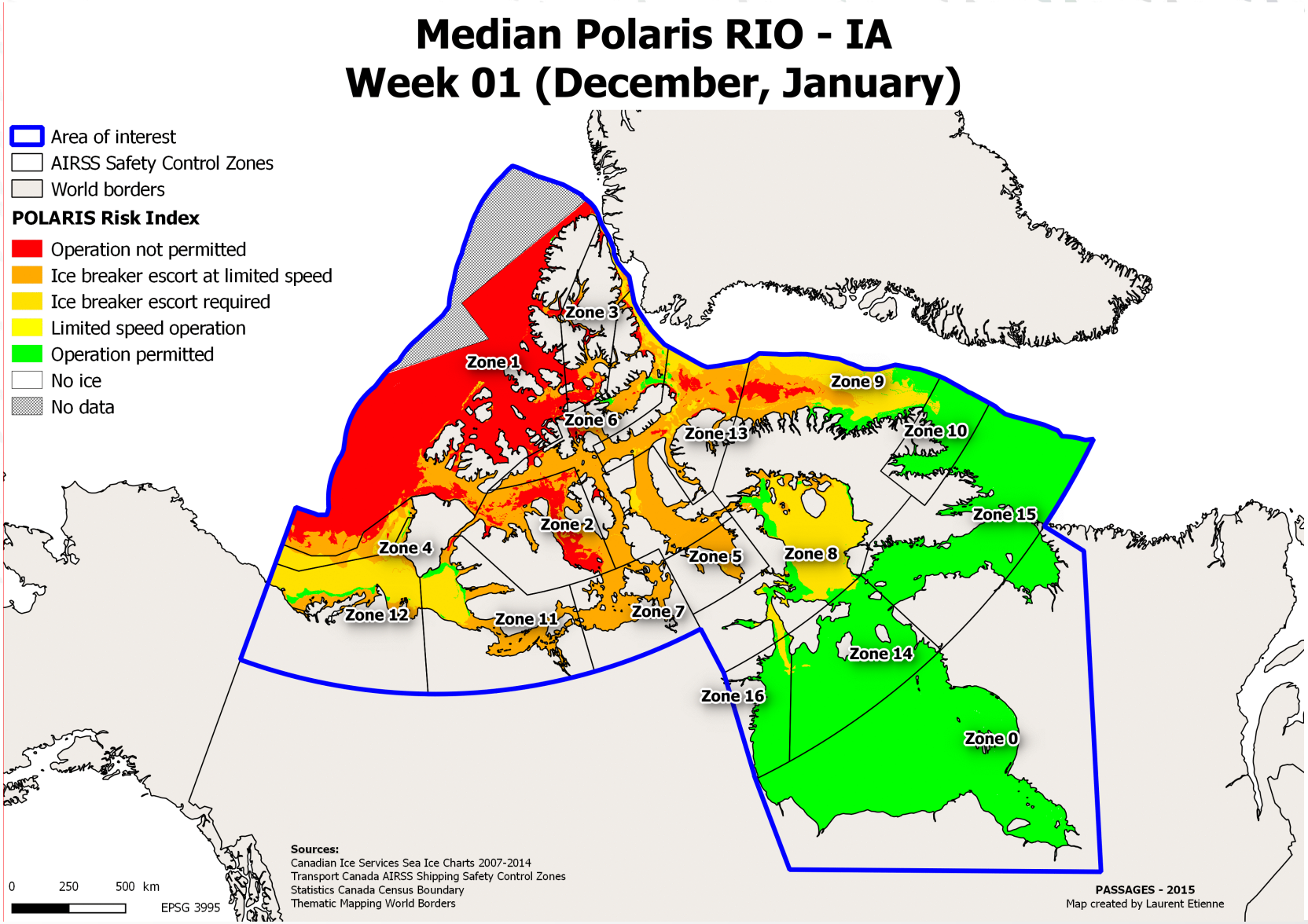



- AOI contains over 4 million grid cells after spatial processing to remove grid cells containing land
- Canadian Ice Service SIGRID-3 ice information from 2004 to 2007 (~314,000 ice polygons) has been associated with each grid cell (a total of 1,283,615,136 intersections).

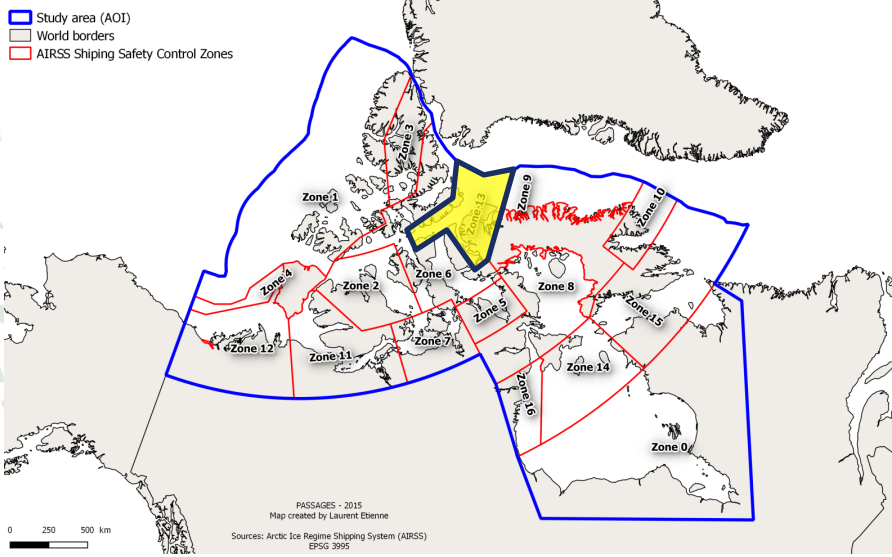
# AOI Risk Visualization - Week 30

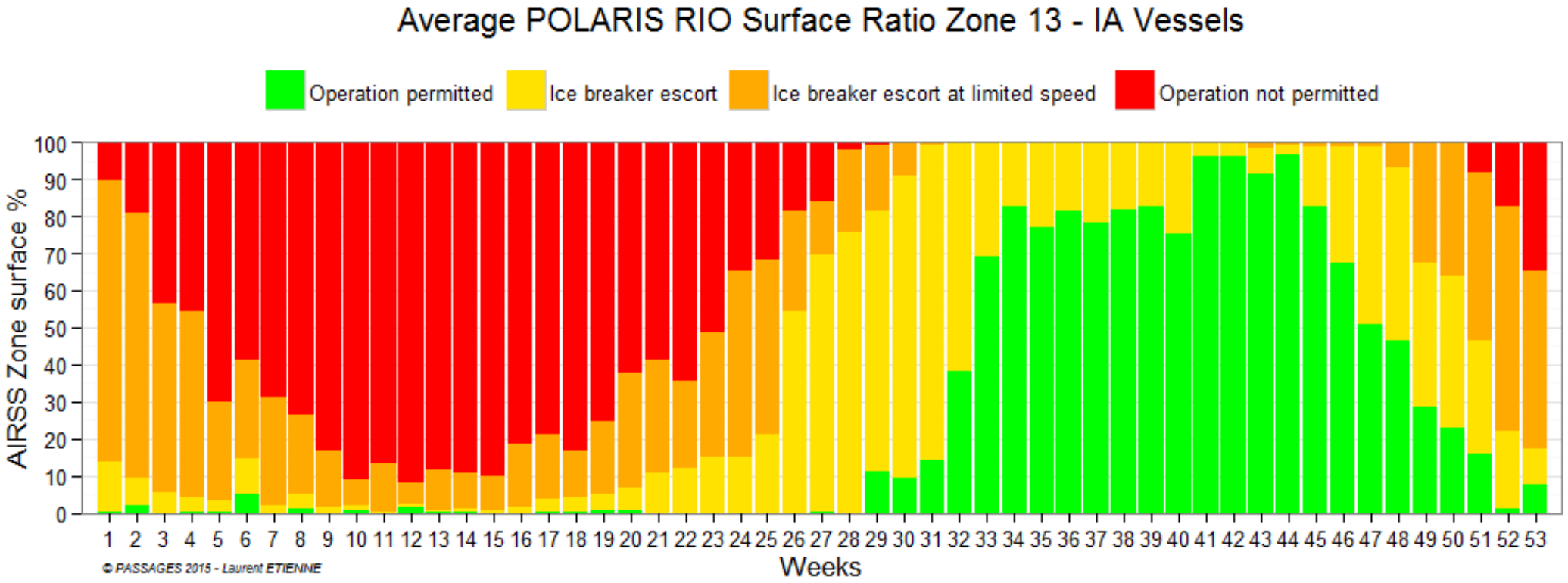


# AOI Risk Visualization – Time Lapse of POLARIS results (52 weeks)

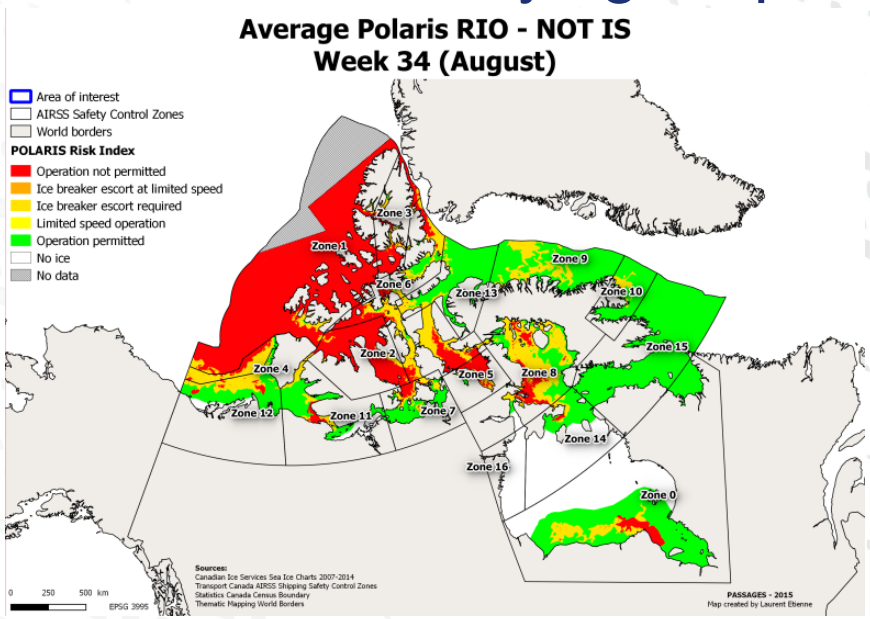


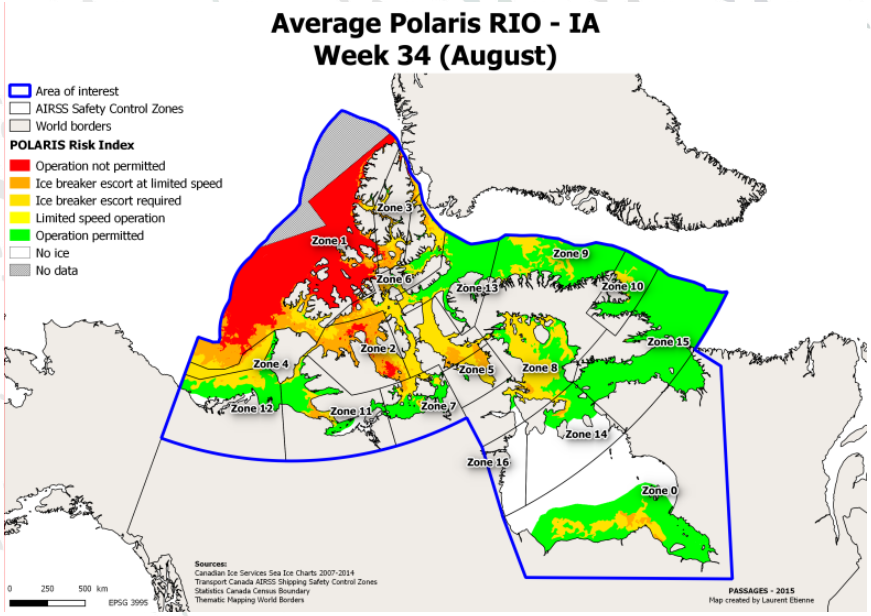
# Risk Visualization – 52 week trend

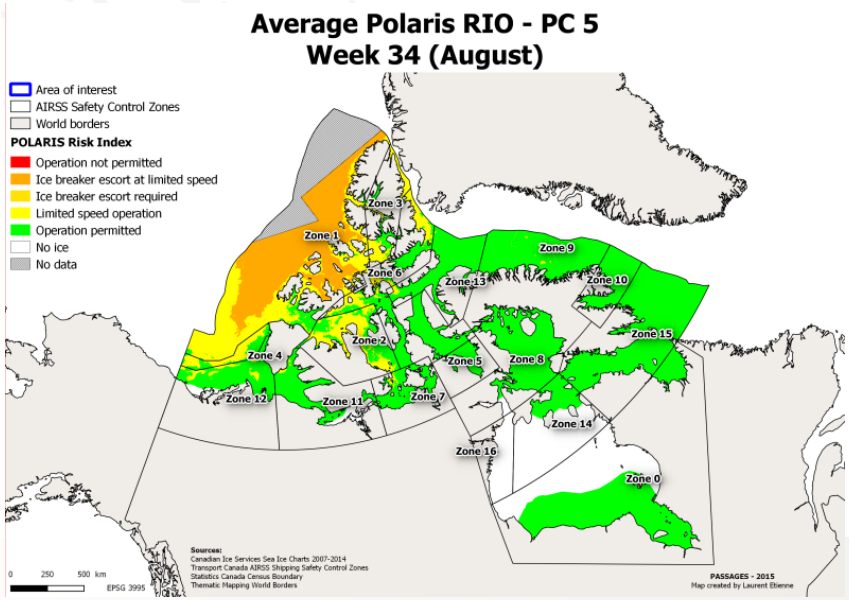


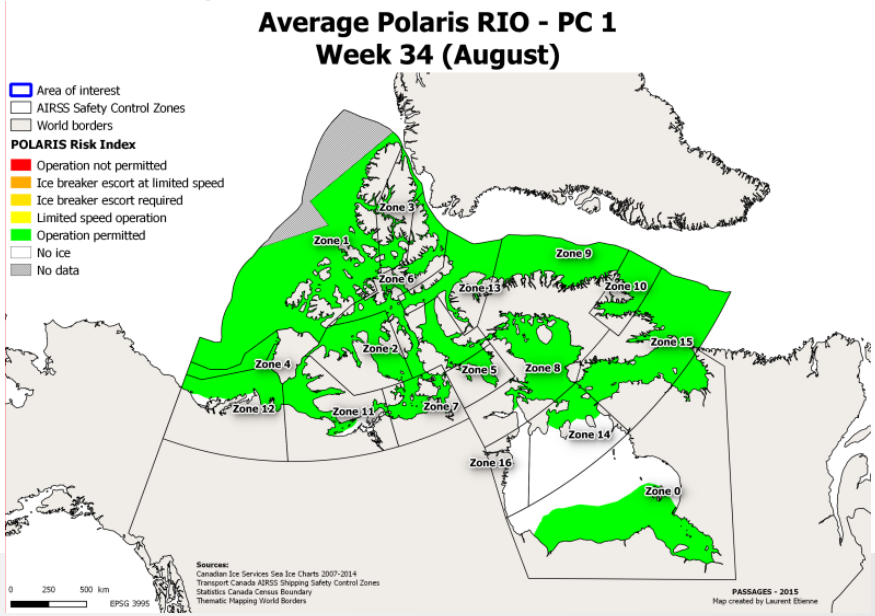



# Risk Visualization - Varying Ship Classification

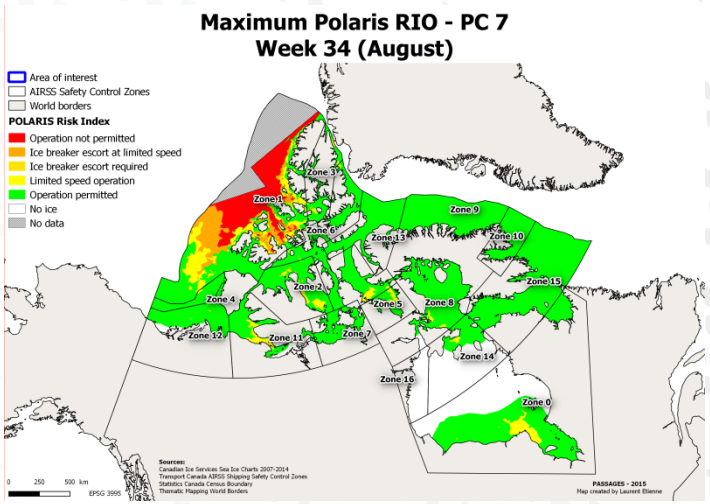


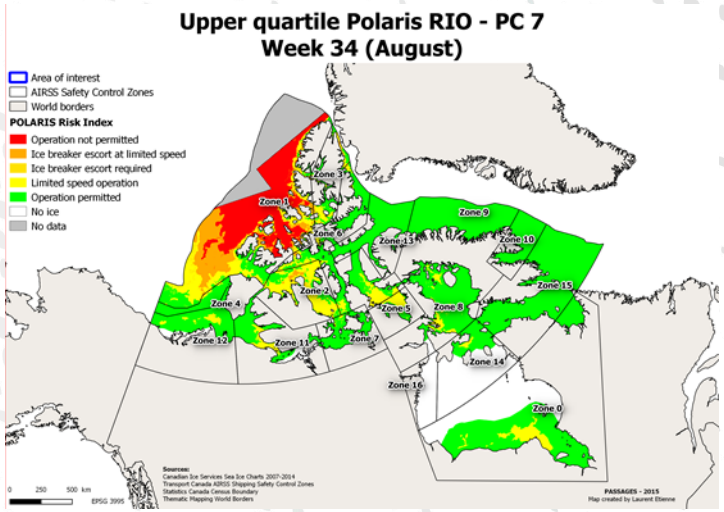



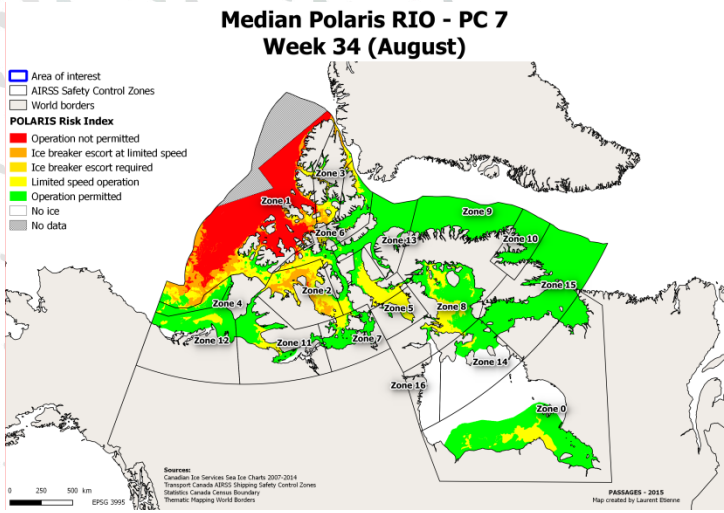



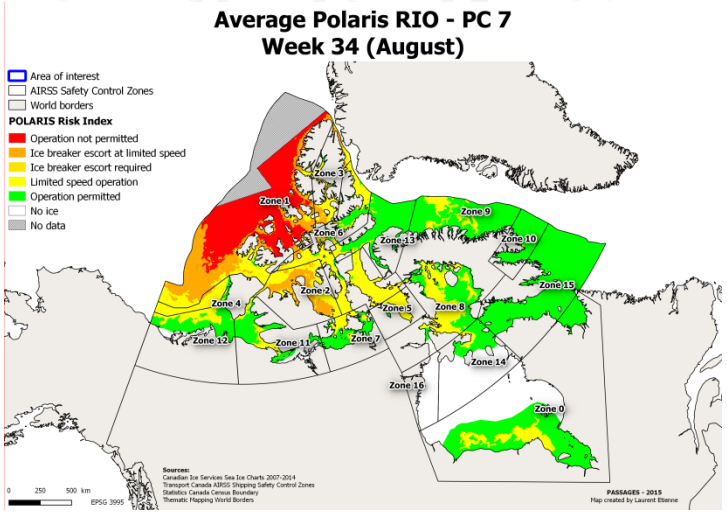



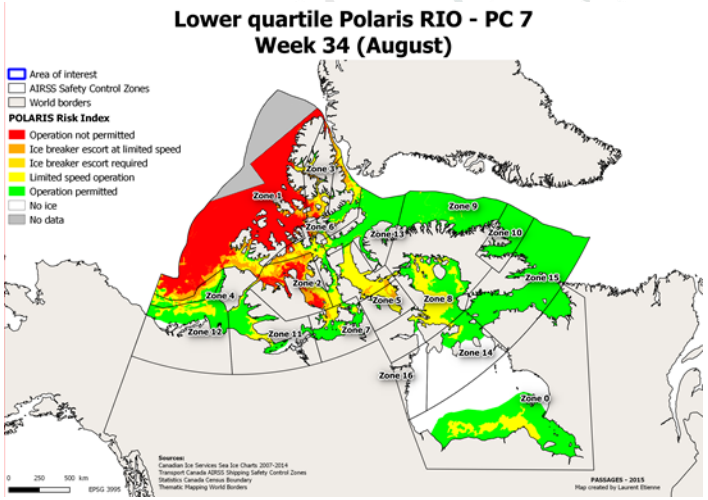
# Statistical Aggregations of POLARIS RIO Results (2007 – 2014)

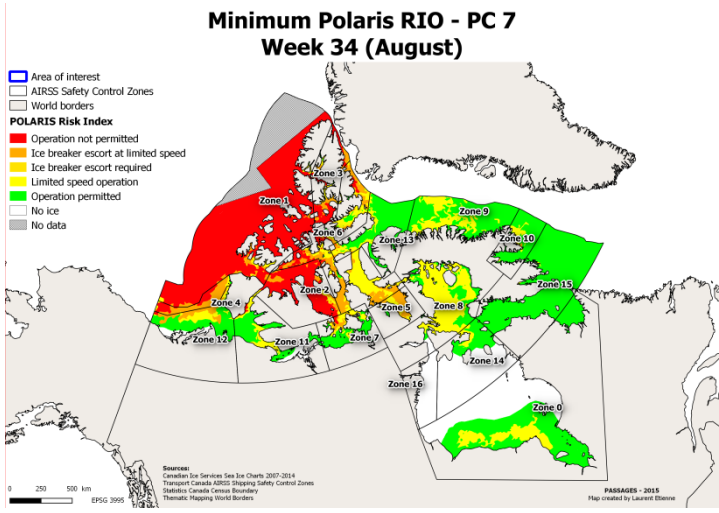


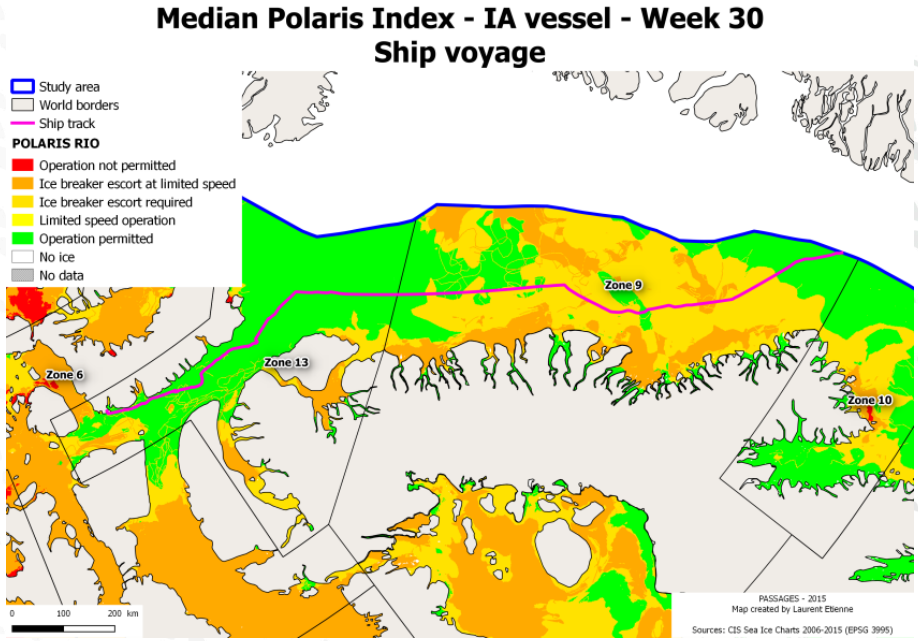



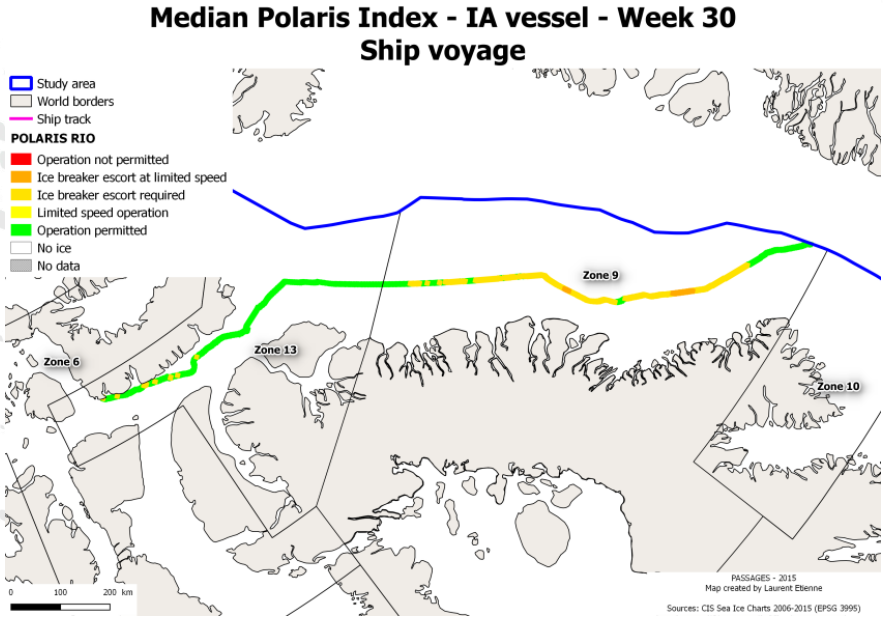



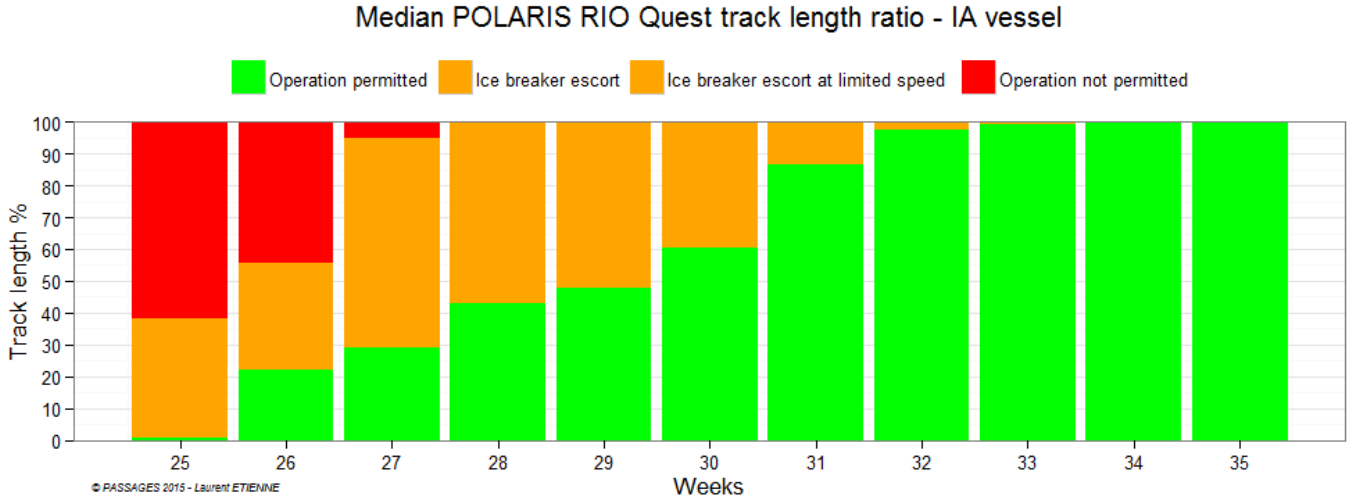



# Risk Visualization - Route Evaluation



# Conclusions

- POLARIS provides an excellent risk assessment framework to assess and visualize ship operational limits over large areas
- POLARIS Scenario Risk Maps can be used to support
  - Strategic appraisal of historical ice conditions and their impact on shipping
  - Route planning and evaluation
  - Ship class selection for particular geographic areas or desired routes
- Future research will explore the use of multi-criteria risk assessment to provide a more comprehensive assessment of arctic maritime risk
  - Ice, extreme weather, remoteness, uncharted or poorly charted bathymetry, etc.

# Acknowledgments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  - exactEarth Ltd.
  - Airbus Defence & Space



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